EMB190 Alerting Issues – Uncommanded Yaw or Roll

1. Initiating Condition: Wake Encounter

Type	Alert or cue	Threshold for alert or cue to be presented	Confusion regarding alert or cue	Other issues with regard to alert or cue	When alert is inhibited/suppressed or when cue is masked	How alert or cue is terminated
Visual Alerts	None					
Aural Alerts	GPWS "Bank Angle"		Alert not definitive as to cause			
Tactile Alerts	None					
Visual Cues	Roll rate on PFD		Underlying cause of the yaw/roll may not be cued, or the cues may be ambiguous/require effortful interpretation			
Aural Cues	None					
Tactile/ Somatic Cues	Wheel may move opposite the roll if autopilot is engaged.		Underlying cause of the wheel deflection may not be cued, or the cues may be ambiguous/require effortful interpretation			

Expected Pilot Response(s)

- Add thrust as necessary
- Disconnect autopilot
- Verify symmetrical thrust
- Confirm spoilers are retracted
- Apply opposing roll and/or yaw inputs to control aircraft attitude
- Pitch to horizon
- Recover from nose-down upset if necessary

Possible sources of confusion with regard to pilot response(s)

- Pilots may have to react to an uncommanded roll with different controls (wheel vs. rudder pedals) depending on the cause, which will probably be unclear based on the lack of definitive cues and the extreme time pressure. (Note: The procedures instruct pilots to use "all available controls" which is an attempt to reduce the diagnostic workload.)

EMB190 Alerting Issues – Uncommanded Yaw or Roll

1. Initiating Condition: Wake Encounter – Cont.

How does pilot know condition is resolved/recovered?

- Condition is resolved when aircraft control is regained.

Issues with regard to multiple concurrent non-normal conditions

- Pilots may be confronted with unusual flight control difficulties and/or secondary alerts/cues as they cope with a roll or yaw/roll upset

EMB190 Alerting Issues – Uncommanded Yaw or Roll

2. Initiating Condition: Uncommanded rudder deflection or rudder pedal kicks

Type	Alert or cue	Threshold for alert or cue to be presented	Confusion regarding alert or cue	Other issues with regard to alert or cue	When alert is inhibited/suppressed or when cue is masked	How alert or cue is terminated
Visual Alerts	None					
Aural Alerts	GPWS "Bank Angle"		Alert not definitive as to cause			
Tactile Alerts	None					
Visual Cues	Roll rate on PFD					
	Yaw rate on Map/MFD					
	Rudder deflection graphically displayed on MFD Flight Controls Synoptic page			This page must be manually selected by the pilots and thus the depiction of rudder deflection would be effortful to obtain		
Aural Cues	None					
Tactile/ Somatic Cues	Lateral-g					

EMB190 Alerting Issues – Uncommanded Yaw or Roll

2. Initiating Condition: Uncommanded rudder deflection or rudder pedal kicks – Cont.

Type	Alert or cue	Threshold for alert or cue to be presented	Confusion regarding alert or cue	Other issues with regard to alert or cue	When alert is inhibited/ suppressed or when cue is masked	How alert or cue is terminated
Tactile/ Somatic Cues	Rudder pedals may deflect in rudder hardover		Underlying cause of the rudder and/or wheel deflections may not be cued, or the cues may be ambiguous/require effortful interpretation. It may not be clear to the pilots whether the control inputs are causing the upset or responding to it.	Interpretation of rudder and wheel deflections can be difficult because the direction of deflection (into or opposite the yaw) depends on the underlying cause		
	Wheel may move opposite the roll if autopilot is engaged.		Underlying cause of the rudder and/or wheel deflections may not be cued, or the cues may be ambiguous/require effortful interpretation. It may not be clear to the pilots whether the control inputs are causing the upset or responding to it.	Interpretation of rudder and wheel deflections can be difficult because the direction of deflection (into or opposite the yaw) depends on the underlying cause		

Expected Pilot Response(s)

- Disconnect autopilot/autothrottle
- Verify symmetrical thrust
- Confirm spoilers are retracted
- Apply opposing roll and/or yaw inputs to control aircraft attitude, using significant force if necessary
- Reduce AOA/pitch/altitude as required to regain roll authority
- Recover from nose-down upset if necessary

Possible sources of confusion with regard to pilot response(s)

- Pilots may have to react to an uncommanded roll with different controls (wheel vs. rudder pedals) depending on the cause, which will probably be unclear based on the lack of definitive cues and the extreme time pressure. (Note: The procedures instruct pilots to use "all available controls" which is an attempt to reduce the diagnostic workload.)

EMB190 Alerting Issues – Uncommanded Yaw or Roll

2. Initiating Condition: Uncommanded rudder deflection or rudder pedal kicks – Cont.

How does pilot know condition is resolved/recovered?

- Condition is resolved when aircraft control is regained and uncommanded control deflections have been either neutralized or compensated for in all anticipated circumstances for the remainder of the flight.
- If there are residual uncommanded control deflections or pressures, there may be operational implications through to landing (e.g., crosswind limitations)

Issues with regard to multiple concurrent non-normal conditions

- Pilots may be confronted with unusual flight control difficulties and/or secondary alerts/cues as they cope with a roll or yaw/roll upset

EMB190 Alerting Issues – Uncommanded Yaw or Roll

3. Initiating Condition: Uncommanded aileron/spoiler/flap/slat deflection

Type	Alert or cue	Threshold for alert or cue to be presented	Confusion regarding alert or cue	Other issues with regard to alert or cue	When alert is inhibited/ suppressed or when cue is masked	How alert or cue is terminated
Visual Alerts	None					
Aural Alerts	GPWS "Bank Angle"		Alert not definitive as to cause			
Tactile Alerts	None					
Visual Cues	Roll rate on PFD					
	Aileron/spoiler deflection graphically displayed on MFD Flight Controls Synoptic page			This page must be manually selected by the pilots and thus the depiction of aileron/spoiler deflection would be effortful to obtain		
Aural Cues	None					
Tactile/ Somatic Cues	Wheel may move opposite the roll if uncommanded flap/slat/spoiler deflection and autopilot is engaged; however, wheel may move in the direction of roll if uncommanded aileron deflection or other causes		Underlying cause of the wheel deflection may not be cued, or the cues may be ambiguous/require effortful interpretation	Interpretation of wheel deflection is difficult because the direction of deflection (into or opposite the roll) depends on the underlying cause		

EMB190 Alerting Issues – Uncommanded Yaw or Roll

3. Initiating Condition: Uncommanded aileron/spoiler/flap/slat deflection – Cont.

Expected Pilot Response(s) Review reference flight control disconnects

- Disconnect autopilot/autothrottle
- Verify symmetrical thrust
- Confirm spoilers are retracted
- Apply opposing roll and/or yaw inputs to control aircraft attitude, using significant force if necessary
- Recover from nose-down upset if necessary

Possible sources of confusion with regard to pilot response(s)

- Pilots may have to react to an uncommanded roll with different controls (wheel vs. rudder pedals) depending on the cause, which will probably be unclear based on the lack of definitive cues and the extreme time pressure. (Note: The procedures instruct pilots to use "all available controls" which is an attempt to reduce the diagnostic workload.)

How does pilot know condition is resolved/recovered?

- Condition is resolved when aircraft control is regained and uncommanded control deflections have been either neutralized or compensated for in all anticipated circumstances for the remainder of the flight.
- If there are residual uncommanded control deflections or pressures, there may be operational implications through to landing (e.g., crosswind limitations)

Issues with regard to multiple concurrent non-normal conditions

- Pilots may be confronted with unusual flight control difficulties and/or secondary alerts/cues as they cope with a roll or yaw/roll upset